

RESEARCH NOTE

PHORETIC PSEUDOSCORPIONS ASSOCIATED WITH FLYING INSECTS IN BRAZILIAN AMAZÔNIA

The oldest record of a phoretic association between pseudoscorpions and flying insects in Brazilian Amazônia is that of *Cordylochernes scorpoides* (Linnaeus 1758) traveling under the wings of the cerambycid beetle *Acrocinus longimanus* (Linnaeus 1758) in Belém (Pará State) (Ellingsen 1905). Beck (1968) and Mahnert (1979) reported the same association from Manaus (Amazonas State) and Aguiar & Bührnheim (1992b) extended this occurrence to Rio Branco (Acre State) and mentioned the same pseudoscorpion being transported by another cerambycid species, *Macrodonia cervicornis* (Linnaeus 1758), from Amazonas. Aguiar & Bührnheim (1992b) also recorded *A. longimanus* carrying two other pseudoscorpions, *Parachelifer lativittatus* (Chamberlin 1923) and *Lustrochernes intermedius* (Balzan 1892), in Amazonas. A photograph of *C. scorpoides* under the wings of *A. longimanus* was given by Höfer & Beck (1995).

Recently, other phoretic associations have been reported from several localities in Brazilian Amazônia. Mahnert & Aguiar (1986) described a new pseudoscorpion species, *Neocheiridium triangulare* Mahnert & Aguiar 1986, found associated with a hawkmoth, the sphingid *Cocytius duponchel* (Poey 1932), in Amazonas and Pará. Mahnert (1987) cited *Semeiochernes militaris* Beier 1932 [a synonym of *S. armiger* (Balzan 1892), according to Zeh & Zeh (1992)], being transported by a brachyceran fly, in Pará. Aguiar & Bührnheim (1991) reported the cerambycid beetle, *Stenodontes spinibarbis* (Linnaeus 1758), carrying three pseudoscorpion species, *Lechytia chthoniiformis* (Balzan 1887), *Neocheiridium corticum* (Balzan 1887) and *Lustrochernes intermedius* (Balzan 1892), all from Roraima State (Maracá Island, Uraricoera river). Aguiar & Bührnheim (1992a) studied five pseudoscorpion species, *Tridenchthonius mexicanus* Chamberlin & Chamberlin 1945, *Americhernes* aff. *incertus* Mahnert 1979,

Lustrochernes intermedius, *Lustrochernes* aff. *reimoseri* Beier 1932 and *Parawithius* (*V.*) *gracilimanus* Mahnert 1979 associated with twelve species of passalid beetles, in Amazonas. Moreover, Aguiar et al. (1992) found *Dolichowithius* (*D.*) *mediofasciatus* Mahnert 1979, being transported by a species of Platypodidae, *Platypus* sp., in Amazonas; and, more recently, Aguiar et al. (1998), in a study of the occurrence of these Withiidae in wood industries situated in urban areas of Manaus (Amazonas), collected another platypodid, *Platypus parallelus* (Fabricius 1801), also carrying *D. mediofasciatus*. Aguiar & Bührnheim (1998) reported *Parachernes* aff. *albomaculatus* (Balzan 1892) in a phoretic association with an unidentified chrysopid neuropteran from Roraima (Maraca Island). Finally, Mahnert (1979) found *Lustrochernes similis* (Balzan 1892) and *Phymatochernes crassimanus* Mahnert 1979 inside a Malaise trap in Amazonas (Manaus) and Aguiar & Bührnheim (1998) similarly found, in Roraima (Maraca Island), four phoretic pseudoscorpion species in the collecting bottles of several insect traps, their hosts remaining unknown.

The insects and phoretic pseudoscorpions studied here were collected in many different localities of Brazilian Amazonia, the majority in Amazonas State (AM), with some in Acre (AC), Pará (PA) and Rondônia (RO) States (Table 1). They were captured using several collecting techniques, including Malaise trap; Shannon trap; Pennsylvania black light BLB trap; mercury vapor/tungsten light on a white sheet; attraction/interception trap (Aguiar et al. 1992; Aguiar et al. 1998); insect collecting net bag and hand picking. They are lodged in the Entomological Collection of the Universidade do Amazonas. Only the Diptera, Tabanidae and the insects coming from the Jaú National Park (Novo Airão, Amazonas) are lodged in the Invertebrate Collection of the

Table 1.—Pseudoscorpion species in phoretic association with flying insects in the Brazilian Amazonia.
 * Denotes the first known association between the host and pseudoscorpion species. Abbreviations: AC = Acre State; AM = Amazonas State; PA = Pará State; RO = Rondonia State.

Phoretic pseudoscorpions	Host insects	New geographical distribution data of the association in Amazonia
Chthoniidae		
<i>Lechytia chthoniiformis</i> (Balzan 1890)	Coleoptera, Cerambycidae	
	<i>Stenodontes spinibarbis</i> (L. 1758)	AM (Coari, Tefé, Uarini)
	<i>Stictosomus semicostatus</i> Serville 1832*	AM (Coari)
	<i>Diploschema</i> sp.*	AM (Novo Airão)
Tridenchthoniidae		
<i>Tridenchthonius mexicanus</i> Chamberlin & Chamberlin 1945	Coleoptera, Passalidae	
	<i>Passalus abortivus</i> Percheron 1835*	AM (Novo Airão)
	<i>Passalus</i> aff. <i>coarctatus</i> Percheron 1835	
	<i>Passalus convexus</i> Dalman 1817	AM (Coari)
	<i>Passalus elfriedae</i> Luederwaldt 1931	
	<i>Passalus interruptus</i> (L. 1758)	AM (Coari, Itacoatiara, Juruá, Novo Airão)
	<i>Passalus interstitialis</i> Eschscholtz 1829	AM (Coari, Juruá, Novo Airão)
	<i>Passalus latifrons</i> Percheron 1841	
	<i>Passalus</i> (<i>M.</i>) <i>spinifer</i> Percheron 1841*	AM (Coari)
	<i>Passalus</i> aff. <i>nasutus</i> Percheron 1835*	AM (Coari)
	<i>Passalus rhodocanthopoides</i> (Kuwert 1891)	AM (Coari, Juruá)
	<i>Passalus unicornis</i> Lep. & Serv. 1825	AM (Coari)
	<i>Passalus variiphyllus</i> (Kuwert 1891)*	AM (Coari)
	<i>Veturius platyrhinus</i> Westwood 1845	
	<i>Veturius transversus</i> (Dalman 1817)	AM (Coari)
Unknown host	AM (Carauari, Uarini)	
Geogarypidae		
<i>Geogarypus amazonicus</i> Mahnert 1978*	Coleoptera, Cerambycidae	
	<i>Acanthoderes thammi</i> Bates 1880*	AM (Coari)
Atemnidae		
<i>Paratemnoides minor</i> (Balzan 1892)	Homoptera, Cicadidae*	AM (Uarini)
	Coleoptera, Endomychidae*	AM (Manaus)
	Coleoptera, Meloidae: <i>Epicauta</i> sp.*	AM (Coari)
	Coleoptera, Cerambycidae: <i>Styliceps</i> sp.*	AM (Manaus)
	Coleoptera, Curculionidae: <i>Cratosomus</i> sp.*	AM (Manaus)

Table 1.—Continued.

Phoretic pseudoscorpions	Host insects	New geographical distribution data of the association in Amazonia
Cheiridiidae		
<i>Neocheiridium triangulare</i> Mahnert & Aguiar 1986	Lepidoptera, Spingidae <i>Amphimoea walkeri</i> (Boisduval 1875)* <i>Cocytius anteus</i> (Drury 1773)* <i>Cocytius duponchel</i> (Poey 1832)	AM (Coari, São Gabriel da Cachoeira) AM (Coari) AM (Coari, Itacoatiara, Juruá, Novo Airão, São Gabriel da Cachoeira, Uarini); RO (Porto Velho); AC (Cruzeiro do Sul)
	<i>Isognathus allamandae</i> Clark 1920* <i>Isognathus menechus</i> (Boisduval 1875)*	AM (São Gabriel da Cachoeira) AM (Coari)
<i>Neocheiridium corticum</i> (Balzan 1887)	Coleoptera, Cerambycidae <i>Stenodontes spinibarbis</i> (L. 1758)	
<i>Neocheiridium</i> sp.	Hemiptera (Heteroptera), Reduviidae <i>Panstrongylus geniculatus</i> (Latreille 1811)*	AM (Iranduba, Novo Airão)
Chernetidae		
<i>Americhermes</i> aff. <i>incertus</i> Mahnert 1979	Coleoptera, Passalidae <i>Passalus</i> aff. <i>coarctatus</i> Percheron 1835 <i>Passalus convexus</i> Dalman 1917 <i>Passalus elfriedae</i> Luederwaldt 1931 <i>Passalus glaberrimus</i> Eschscholtz 1829* <i>Passalus</i> aff. <i>nasutus</i> Percheron 1835* <i>Passalus unicornis</i> Lep. & Serv. 1825 <i>Passalus variiphyllus</i> (Kuwert 1891) <i>Veturius paraensis</i> Luederwaldt 1927* <i>Veturius platyrhinus</i> Westwood 1845	AM (Coari) AM (Coari) AM (Coari) AM (Coari) AM (Coari, Uarini)
<i>Americhermes bethaniae</i> Mahnert 1979*	unknown host	AM (Coari)
<i>Lustrochermes intermedius</i> (Balzan 1892)	Coleoptera, Passalidae <i>Passalus abortivus</i> Percheron 1835* <i>Passalus interruptus</i> (L. 1758)* <i>Passalus interstitialis</i> Eschscholtz 1829 <i>Passalus rhodocanthopoides</i> (Kuwert 1891) <i>Paxillus leachi</i> MacLeay 1819* <i>Spasalus robustus</i> (Percheron 1835)*	AM (Novo Airão) AM (Coari, Novo Airão) AM (Barcelos, Carauari, Coari, Juruá) AM (Coari) AM (Uarini) AM (Uarini)
	Coleoptera, Cerambycidae <i>Acrocinus longimanus</i> (L. 1758) <i>Callipogon (Orthomegas)</i> sp.* <i>Macrodonia</i> sp.* <i>Stenodontes spinibarbis</i> (L. 1758)	AM (Coari) AM (Manaus) AM (Tefé)

Table 1.—Continued.

Phoretic pseudoscorpions	Host insects	New geographical distribution data of the association in Amazonia
<i>Lustrochernes</i> aff. <i>reimoseri</i> Beier 1932	Coleoptera, Passalidae	
	<i>Passalus abortivus</i> Percheron 1835	AM (Novo Airão)
	<i>Passalus</i> aff. <i>coarctatus</i> Percheron 1835	
	<i>Passalus convexus</i> Dalman 1817	AM (Coari)
	<i>Passalus elfriedae</i> Luederwaldt 1931	
	<i>Passalus glaberrimus</i> Eschscholtz 1829*	AM (Coari)
	<i>Passalus interruptus</i> (L. 1758)	AM (Coari)
	<i>Passalus interstitialis</i> Eschscholtz 1829	AM (Novo Airão)
	<i>Passalus latifrons</i> Percheron 1841	
	<i>Passalus</i> (<i>M.</i>) <i>spinifer</i> Percheron 1841*	AM (Coari)
	<i>Passalus</i> aff. <i>nasutus</i> Percheron 1835*	AM (Coari)
	<i>Passalus rhodocanthopoides</i> (Kuwert 1891)	
	<i>Passalus unicornis</i> Lep. & Serv. 1825	AM (Coari)
	<i>Passalus variiphyllus</i> (Kuwert 1891)	AM (Juruá)
	<i>Popilius marginatus</i> (Percheron 1835)*	AM (Coari)
	<i>Popilius tetrephyllus</i> (Eschscholtz 1829)*	AM (Tefé)
	<i>Veturius platyrhinus</i> Westwood 1845	
	<i>Veturius transversus</i> (Dalman 1817)	AM (Coari)
	<i>Veturius</i> sp.*	AM (Coari)
<i>Verres furcibris</i> (Eschscholtz 1829)		
<i>Lustrochernes similis</i> (Balzan 1892)	Coleoptera, Cerambycidae	
	<i>Acanthoderes thammi</i> Bates 1880*	AM (Coari)
	<i>Steirastoma melanogulys</i> Withe 1855*	AM (Coari, Novo Airão, Presidente Figueiredo, Uarini)
	<i>Compsibidion maronicum</i> (Thomson 1867)*	AM (Manaus)
<i>Cordylochernes scorioides</i> (L. 1758)	Coleoptera, Cerambycidae	
	<i>Acrocinus longimanus</i> (L. 1758)	AM (Juruá, Novo Airão, São Gabriel da Cachoeira, Tefé)
	<i>Macrodonia cervicornis</i> (L. 1758)	AM (Itacoatiara)
<i>Parachernes adisi</i> Mahnert 1979	<i>Titanus giganteus</i> (L. 1771)*	AM (Manaus)
	unknown host	AM (Guajará)
<i>Parachernes</i> aff. <i>adisi</i> Mahnert 1979	unknown host	AM (Coari)
<i>Parachernes</i> aff. <i>albomaculatus</i> (Balzan 1892)	Neuroptera, Chrysopidae	
	unknown host	AM (Tefé)

Table 1.—Continued.

Phoretic pseudoscorpions	Host insects	New geographical distribution data of the association in Amazonia
<i>Parachernes inpai</i> Mahnert 1979*	Diptera, Culicidae*	AM (Novo Airão)
	Diptera, Tabanidae <i>Phorcotabanus cinereus</i> (Wiedemann 1821)*	AM (Manaus)
	<i>Tabanus occidentalis</i> L. 1758*	PA (Monte Alegre)
<i>Parachernes melano- pygus</i> Beier 1959*	Diptera, Tabanidae <i>Phorcotabanus cinereus</i> (Wiedemann 1821)*	AM (Manaus)
	<i>Stenotabanus cretatus</i> Fairchild 1961*	AM (Manaus)
	<i>Tabanus amapaensis</i> Fairchild 1961* unknown host	AM (Manaus) AM (Manaus); RO (Ariquemes)
<i>Parachernes plumosus</i> (White 1908)*	Diptera, Tabanidae <i>Phorcotabanus cinereus</i> (Wiedemann 1821)*	AM (Manaus)
	<i>Stenotabanus cretatus</i> Fairchild 1961*	AM (Novo Airão)
	<i>Tabanus trivittatus</i> Fabricius 1805* unknown host	AM (Uarini) AM (Carauari, Coari)
<i>Phymatochernes crassimanus</i> Mahnert 1979		
<i>Semeiochernes armiger</i> (Balzan 1892)	Diptera, Pantophthalmidae	
<i>Parazaona</i> sp.	Hemiptera (Heteroptera), Reduviidae <i>Panstrongylus geniculatus</i> (Latreille 1811)*	AM (Novo Airão)
Withiidae		
<i>Parawithius</i> (V.) <i>gracilimanus</i> Mahnert 1979	Coleoptera, Passalidae <i>Passalus elfriedae</i> Luederwaldt 1931 <i>Passalus interruptus</i> (L. 1758) <i>Passalus interstitialis</i> Eschscholtz 1829 <i>Passalus rhodocanthopoides</i> (Kuwert 1891) <i>Passalus unicornis</i> Lep. & Serv. 1825 Unknown host	AC (Rio Branco)
<i>Parawithius</i> sp.	Hemiptera (Heteroptera), Reduviidae <i>Caridomma</i> sp.*	AM (Itacoatiara)
<i>Dolichowithius</i> (D.) <i>mediofasciatus</i> Mahnert 1979	Coleoptera, Platypodidae <i>Platypus parallelus</i> (Fabricius 1801) <i>Platypus</i> sp. unknown host	AC (Plácido de Castro) AC (Plácido de Castro) AM (Coari, São Sebastião do Uatumã)
<i>Dolichowithius</i> (D.) aff. <i>longichelifer</i> (Balzan 1887)*	unknown host	AM (Coari)

Table 1.—Continued.

Phoretic pseudoscorpions	Host insects	New geographical distribution data of the association in Amazonia
<i>Cacodemonius</i> sp. 1	Coleoptera, Cerambycidae	
	<i>Callipogon (Orthomegas)</i> sp.*	AM (Coari)
	Coleoptera, Passalidae	
	<i>Passalus rhodocanthopoides</i> (Kuwert 1891)*	AM (Coari)
<i>Cacodemonius</i> sp. 2	Coleoptera, Passalidae	
	<i>Passalus abortivus</i> Percheron 1835*	AM (Novo Airão)
	<i>Passalus punctiger</i> Lep. & Serv. 1825*	AM (Coari)
	<i>Paxillus leachi</i> MacLeay, 1819*	AM (Coari)
	Coleoptera, Cerambycidae	
	<i>Stenodontes spinibarbis</i> (L. 1758)*	AM (Coari, Tefé, Uarini)
	<i>Callipogon (Orthomegas)</i> sp.*	AM (Coari)
Cheliferidae		
<i>Parachelifer lativittatus</i> (Chamberlin 1923)	Coleoptera, Cerambycidae	AM (Juruá, Novo Airão, São Gabriel da Cachoeira, Tefé, Uarini)
	<i>Acrocinus longimanus</i> (L. 1758)	

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Phoretic associations with flying insects were found in 19 of the 64 described pseudoscorpion species that are known to occur in the Brazilian Amazonia (Harvey 1991), along with 10 other morphospecies, which are presumably undescribed. Twenty four of these species were found with 56 insect species, belonging to five orders (Hemiptera, Neuroptera, Coleoptera, Lepidoptera and Diptera); and the remaining five species were associated with unknown hosts, since they were found free in flying insects traps, probably brought by some of the countless insects collected. Only more detailed studies will allow us to ascertain the host insect species.

The Coleoptera proved to be the most frequent insect carriers of pseudoscorpions in the Amazonian region, representing 40 of the 56 host species (Table 1). The 23 species of passalid beetles collected were each found to carry as many as five pseudoscorpion species, and individual hosts sometimes carried three pseudoscorpion species, one on the pronotum and the others under the wings (Aguiar & Bührnheim 1992a). Twelve species of cerambycid beetles were found to carry pseudoscorpions, some of which were involved with the regular phoretic transport of certain pseudoscorpions, such as *Acrocinus longimanus*,

frequently carrying both *Cordylochernes scorpioides* under the wings and *Parachelifer lativittatus* behind the pronotal lateral spine (Aguiar & Bührnheim 1992b). Another cerambycid beetle, *Stenodontes spinibarbis*, was found to carry four pseudoscorpion species, sometimes with three species under the wings of a single host (Aguiar & Bührnheim 1991). A third cerambycid beetle, *Steirastoma melanogulyis* White 1855, was observed for the first time to be carrying *Lustrochernes similis* gripped to the third antennal segment (first segment of the antennal flagellum), a mode of transport found to be quite frequent. Platypodid beetles proved to be important carriers of *Dolichowithius (D.) mediofasciatus* (Aguiar et al. 1992; Aguiar et al. 1998). Many of the host beetles, such as Passalidae and Cerambycidae, are inhabitants of fallen rotting trunks and, not surprisingly, many of the pseudoscorpions that they carry also live in this environment (Mahner & Adis 1985).

Among the Lepidoptera, five species of Sphingidae were found carrying only *Neochelidium triangulare*. *Cocytius duponchel* (Poey 1832) was the most common carrier of this pseudoscorpion species, whose habitat has not yet been discovered.

Amongst the Diptera, the Tabanidae were represented by five species carrying three pseudoscorpions: *Parachernes plumosus*

(With 1908) was always found attached to an abdominal tergite, whereas *P. inpai* Mahnert 1979 and *P. melanopygus* Beier 1959 were always found attached to the hind legs of the host. These pseudoscorpion species were never found sharing the same fly, and individuals were always alone on each fly. Other host Diptera included a culicid carrying *P. inpai*, a forest canopy inhabitant, and a pantophtalmid, reported only as Diptera by Mahnert (1987), carrying nine individuals of *Semeiochernes militaris* (= *S. armiger*) on the same host specimen.

Some Hemiptera were also found carrying pseudoscorpions, including an unidentified Cicadidae (Homoptera) carrying *Paratemnoides minor* (Balzan 1892), a bark tree-trunk inhabitant, and two Reduviidae (Heteroptera), one Triatominae, *Panstrongylus geniculatus* (Latreille 1811), which occurred once carrying *Neocheiridium* sp. and on another occasion, carrying *Parazaona* sp., as well as a species of Cetherinae, *Caridomma* sp., carrying an unidentified species of *Parawithius*.

In some of the more frequent associations studied, nymphal pseudoscorpions were found in phoretic associations as frequently as adult males and females (Mahnert & Aguiar 1986; Aguiar et al. 1992; Aguiar & Bührnheim 1992a).

Future studies on the phoretic behavior of these arachnids are clearly warranted, especially of the associations that occur frequently. New associations undoubtedly remain to be discovered, since our knowledge of Amazonian pseudoscorpions needs to be extended to cover larger geographical and environmental ranges. There is also a lack of natural history studies of the host insects and their phoretic pseudoscorpions in Amazonia. When these studies are undertaken, it should help elucidate the relationships of these arthropod populations.

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